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NASA'S
LESSONS LEARNED AND TECHNICAL STANDARDS
A
LOGICAL MARRIAGE

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Lessons Learned have been the basis for our accomplishments throughout the ages. They have been passed down from father to son, mother to daughter, teacher to pupil, and older to younger worker. Lessons Learned have also been the basis for NASA's accomplishments for more than forty years. Both government and industry have long recognized the need to systematically document and utilize the knowledge gained from past experiences in order to avoid the repetition of failures and mishaps. Lessons Learned have formed the foundation for discoveries, inventions, improvements, textbooks, and Technical Standards.

What are Lessons Learned? Lessons Learned are the result of experiences with people, nature, and the products of our labors. The experiences may be positive, as in successful tests or missions, or negative, as in a mishap or failure. A Lesson Learned must be significant in that it has a real or assumed impact on operations, valid in that it is technically correct, and applicable in that it addresses a specific design process or decision that mitigates or eliminates the potential for failures, or reinforces a positive result.

The documentation of Lessons Learned is important in order to convey information on experiences, control recurrence, improve safety, enhance risk management, and facilitate improved interoperability. Thus, they are an important and critical resource that can be used by engineers, scientists, and technicians to support the design of flight and ground support hardware, software, facilities, and procedures. Sometimes Lessons Learned are also referred to as Best Practices.

What are Technical Standards? As life becomes more complex, more guidance is needed. Technical Standards are the documents that infuse this guidance throughout the social structure. The scope of Technical Standards includes standards, specifications, guidelines, recommended practices, and handbooks. Technical standards are: (1) Systematic collections of proven guidance/methods/requirements (frequently gleaned

from Lessons Learned) integrated into recommended practices, (2) Generally based on inputs from many activities combining the expertise of national or even international experts, and (3) The basic tools commonly used as the foundation for the normal design/development process. Technical Standards educate users, simplify information, and conserve experiences. They are the essential tools in the interaction of people with their environment. They enable us to intelligently pass on knowledge and associated Lessons Learned for others to build upon. Technical Standards are a very logical way to communicate Lessons Learned.

The Problem: With the "explosion" in technical accomplishments during the past century, especially during the last few decades, the ability to rapidly communicate Lessons Learned, and the knowledge gained therefrom, has become critical. This is very true for activities associated with NASA's Programs/Projects relative to producing more advanced products within the "better, faster, cheaper" philosophy. The dependence upon "word-of-mouth" and textbooks to communicate Lessons Learned, while still important, is no longer adequate or realistic. Expecting our engineers and scientists to search through the ever-increasing number and contents of Lessons Learned databases has proven to be less than productive. It is difficult for most engineers to search for and use Lessons Learned. However, there is a viable solution to this problem, at least within NASA.

A Solution: The "marriage" of Lessons Learned with current Technical Standards offers the opportunity for significant improvement in our goal to achieve "better, faster, cheaper" advanced products and the use of current products. The NASA Technical Standards Program sponsored by the NASA Chief Engineer, through the use of its Preferred Technical Standards database, offers the foundation to accomplish this goal.

How? All NASA Programs/Projects are based on the application of Technical Standards, whether produced by NASA, other government organizations including DOD, or by non-government standards developing organizations such as SAE, ASTM, ASME, IEEE, AIAA, etc. These and other Technical Standards have gone through an extensive Agency-wide review process pending their adoption/endorsement as NASA Preferred Technical Standards. Given this select database of Preferred Technical Standards, along with the existence of screened Lessons Learned databases, a productive "marriage" is now readily possible. The active application of Lessons Learned is a principal component of an organizational culture committed to continuous improvement.

The Approach: On the surface this "marriage" appears to be an easily achieved action. However, such is not the case. While the task is readily achievable, it requires the talents of dedicated and experienced engineers who must also possess the gifts of persistence and meticulous attention to detail. The material involved must be read and interpreted and then correlated. The Lessons Learned databases must be related to the NASA's Preferred Technical Standards database which currently has over 1500 entries. Both databases continue to grow at a prolific rate. (If this endeavor is as successful as anticipated, consideration should be made to expand the effort beyond the NASA Preferred Technical Standards database, perhaps with the collaboration of non-government standards developing organizations.) Once related the Lessons Learned must be reviewed and associated with the applicable Technical Standard(s). The result will be

an invaluable database whereby any NASA Preferred Technical Standard required for an Agency Program/Project design, development, or operations process will also have identified with it any Lesson(s) Learned having applications. This "marriage" will without doubt significantly enhance the accomplishment of "better, faster, cheaper" NASA products.

The resulting Integrated Preferred Technical Standards and Lessons Learned System should be reflected in any revision of NPD 7120.5A "NASA Program and Project Management Processes and Requirements" as a required element of the Program/Project management process. Also, this should be reflected in NPD 8700.1 "NASA Policy for Safety and Mission Success". Technical Standards with associated Lessons Learned may be candidates for revision or updating. Lessons Learned that are not associated with an existing Technical Standard should be considered relative to the development of a new Technical Standard. (Here show the "example" chart in reduced size to fit straight up onto page.)

Value: NASA conscientiously investigates, documents, and tracks all of its successes and failures. Yet, all of that work is meaningless if the Agency fails to incorporate these experiences into our ongoing and future Programs/Projects and their operations. They need a viable mechanism to identify and incorporate Lessons Learned into their design, development, and operations efforts, thus reducing mission risk. The cost of achieving the "marriage" of Lessons Learned and Technical Standards will be modest compared to the significant results that will be achieved.

There is no guarantee that future mishaps like the recent two JPL Mar's Missions will not occur. However, the existence of this Integrated Technical Standards and Lessons Learned System will certainly contribute toward minimizing such risks. Only one Mission saved, or whose performance is enhanced, will repay the cost of developing this Integrated Technical Standards System many fold. Without this "marriage" the NASA Lessons Learned database, and other similar databases, will continue to find limited and very focused utility relative to the development and operation of the Agency's future Programs/Projects.

Recommendation: In the near term, links should be established as soon as practical between Lessons Learned and, where possible, ant Technical Standard(s) to which they relate. Users of the Technical Standards would then have immediate links/access to Lessons Learned and other relevant information as they select and apply Technical Standards in the normal design, development, and operations process.

The longer-term goal is to update Technical Standards, where required, to reflect Lessons Learned. Normal practice in the standards community is for Technical Standards to be updated at least once in five years. Links to Lessons Learned will provide a basis for updates of NASA Preferred Technical Standards, facilitating the process. For NASA developed Technical Standards, the additions can be made directly whenever prudent. For non-NASA Technical Standards, the information can be provided to the organization responsible for the Technical Standard (e.g. DoD for MIL-standards documents, and Standards Developing Organizations such as ASTM, IEEE, etc. for Voluntary Consensus Standards). To accomplish this goal, and thus reduce mission risk, it is recommended that

a process be established to integrate Lessons Learned with the NASA Technical Standards System. Specifically,

1. The Lessons Learned entry form should be modified to add blocks requesting the following for each new Lesson Learned identified:
   a. "Identify known Technical Standards that treat topics related to this Lesson Learned"
   b. "Does this Lesson Learned suggest the need for a new Technical Standard?"

2. To the extent practical, existing Lessons Learned should be reviewed to identify related Technical Standards so they can be correlated with those on the NASA Preferred Technical Standards list.

3. Establish links to appropriate Lessons Learned for each identified Technical Standard in the NASA Preferred Technical Standards database.

4. Establish a process for integrating Lessons Learned into identified Technical Standards when they are updated.

5. Evaluate the practicality of retiring Lessons Learned to an "Archival Lessons Learned" database once they have been incorporated into appropriate Technical Standards. At least tag them with links to the Technical Standard into which they have been incorporated. Moving incorporated Technical Standards to an available "Archive" would have the advantage of focussing the main database on fresh, unincorporated information. Alternately, if all Lessons Learned are retained in a common database, tagging incorporated Lessons Learned with links to the Technical Standards into which they have been incorporated would at least lead users to sources where the lessons were integrated into the overall design, development, and operations process.

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